ON THE LATE WINTER AND EARLY SPRING MIGRATION OF THE INDIAN SHAD, *HILSA ILISHA* (HAMILTON), IN THE GANGETIC DELTA

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The migration of the Indian Shad, *Hilsa ilisha* (Hamilton), up the major river systems when they are in floods is well known. Some time ago, while making observations on the biology and fishery of *Hilsa* in Bengal and Orissa, a regular small-scale movement of the fish was noticed from the lower reaches of estuaries soon after the peak of winter season, even in the absence of floods (Jones, 1952). The observations were summarised by the author in the following lines (Jones, 1952, p. 66). "The two periods of migration of the fish observed during the years under study both in the Chilka Lake and the Hooghly River were correlated with floods during the monsoon rains and to the general rise in temperature of the water in the estuaries after the close of winter." In the Hooghly, this ascent of the fish takes place usually early in February and is also associated with some breeding activity (Jones and Menon, 1951). During this time *Hilsa* fishing operations are carried out in the river on a small-scale with the help of the Clapnet, *shangla-jal*. In the Chilka Lake, in Orissa, a similar migration takes place in January-February when the fish is reported to be caught in the channel area connecting the sea and the lake (Jones and Sujansingani, 1951). It is of interest to mention here that a similar activity has been recorded by Kulkarni (1951) for the *Hilsa* in the Narbada where there is a small run beginning in March and continuing up to the middle of April. After referring to the early run of *Hilsa* in the Indus and the Irrawaddy due to floods caused by the melting of snows, he says that "in the Narbada, however, there is no such possibility, as at no stage the river passes through any snow clad mountains and there is not the slightest increase in the level of water in March and April". In the Indus the *Hilsa* comes up from the sea by about February and forms a fishery in the river from March to September (Day, 1873 and Quereshi, 1952). In the rivers of Burma also, it is reported to move up at the close of winter just as in Bengal (Kyaw, 1955).

The fact that floods are essential for the large-scale ascent of *Hilsa* and that "the main body of these fish swarm up all the larger rivers of India and Burma" for breeding with the commencement of the monsoon, has been

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observed by Day (1873 and 1878) who even pointed out the possibility of the presence of two classes of migrants. While the migration of *Hilsa* during the monsoon season as stated by Day (*op. cit.*) and Hora and Nair (1940) could be attributed to the flooded condition of the rivers and the state of sexual maturity of the fish, we could rule out the influence of floods as a

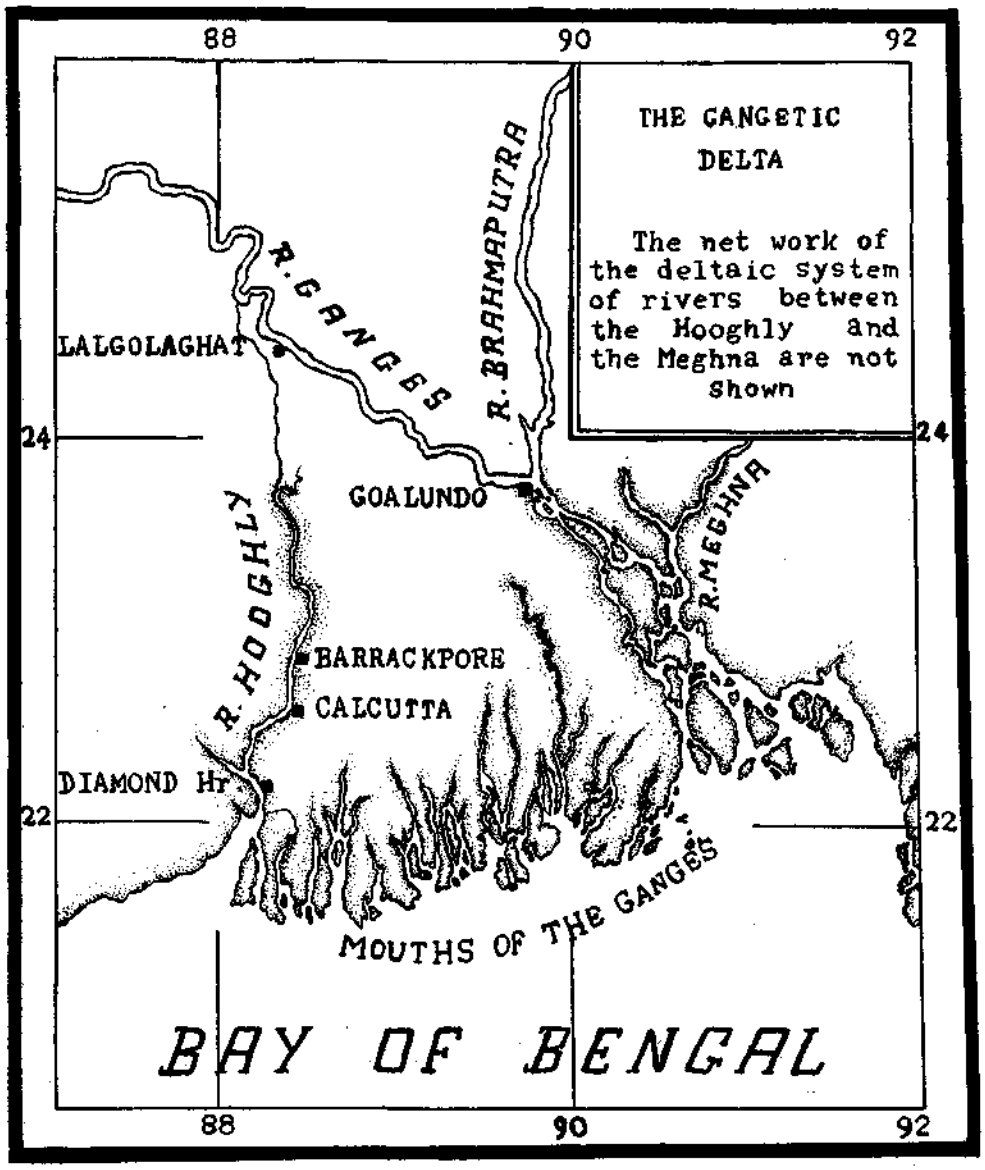

FIG. 1. The Gangetic Delta showing the places mentioned in the article.

contributory factor for the late winter migration. Amongst other possible factors, the one that deserves serious consideration is temperature. Investigations on the American shad have definitely shown that temperature is one of the important factors affecting its migration (Leach, 1925 and Talbot, 1953). The migration of the fish begins with the advent of warm weather both on the Atlantic and the Pacific Coasts. Leach (*op. cit.*) says, " Its movements are apparently largely controlled by the water temperature. It is believed that it seeks to occupy an area having a temperature of 60° or 70° F. and that its migrations are determined by the shifting of this area." The earliest run of the American shad is in Florida in the south in November-December, where the peak is reached in February-March. With the advent of warm weather, the migratory zone shifts progressively towards the north and in the state of Maine the fish is first taken in April and last by the end of July with a peak in May-June. Leim (1924) also correlates the increased migratory and spawning activity of Shad on the Atlantic Coast of Canada to the general rise in temperature of the water. A comparative study by Talbot (1953) of the daily shad count, water temperature and river flow for a number of years through fishways at Bonneville Dam has given very interesting and reliable conclusions. According to him the shad, as measured by the counts, appeared to be early when the river flow dropped early and when the temperature warmed early. That the flow alone is not the main contributory factor is evident from the fact when flow was high and temperature low, the runs tended to be later in passing through the fishways. The findings are summarised by Talbot (*op. cit.*, p. 28) as follows:—

> " Time of passage was influenced both by flow and by temperature, but flow appeared to have the greater effect. Low water flows (and to some extent high water temperatures) tended to result in earlier runs than those occurring when high water flows (and lower water temperatures) prevailed. These conditions affecting the runs at Bonneville apparently affect shad in general in the Columbia River since there was a significant correlation between time of run at Bonneville and time of commercial catch of shad in the river below."

His observation that the river discharge appears to be the more important of the two factors is of special interest since it helps to corroborate the tentative inference arrived at earlier by Jones and Sujansingani (1951 and 1954) after a study of the flow of water over the Naraj Anicut and *Hilsa* catches in the Chilka Lake.* The observations of Kulkarni (1953) on the Narbada *Hilsa* are also in support of this.

* The good *Hilsa* fishery in 1957 in the Cauvery in South India gives additional support to this view.

We have unfortunately no reliable statistics regarding *Hilsa* catches in the Gangetic system of rivers. Generally, statements about fluctuations in catches are only comparative and subject to considerable error in judgement

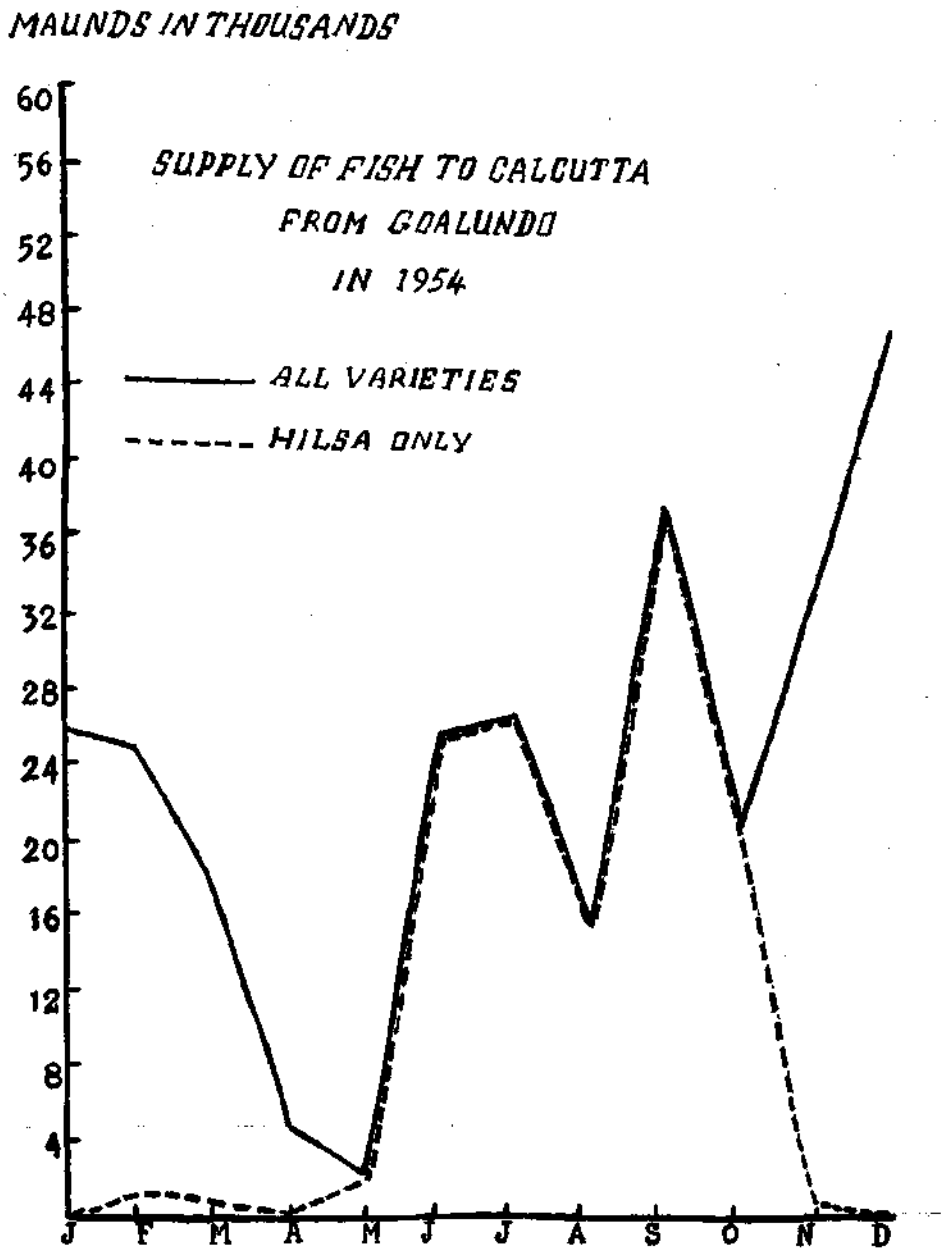

FIG. 2. Graph showing the supply of fish from Goalundo to the Calcutta Markets in 1954.

from person to person and year to year. Even with regard to the migration that begins at the close of winter, it is not definitely known, as Kulkarni (1951) says, with regard to the Narbada *Hilsa* " whether it actually ceases after some time or develops into the major run in July-August."

A very interesting record which helps to throw indirectly, considerable light on the normal seasonal fluctuations in abundance of *Hilsa*, high up in the Gangetic Delta, is made by Nayudu (1939) in his " Report on a survey of the Fisheries of Bengal". According to him, the output of ice in the Rajbari Ice Factory, Goalundo (Fig. 1), from 1934-35 to 1937–38, " reveals certain *surprising and indisputable evidence** of the migration of *Hilsa*". Before the partition of the country there was unrestricted trade between the two Bengals and in view of the high demand for fish in the cities of Calcutta and Howrah and their suburbs most of the fish catches were used to be preserved in ice and despatched to West Bengal.

TABLE I

Statement of output of ice in the Rajbari Ice Factory†

	1934–35	1935–36	1936–37	1937–38
January ..	1,933 from 25th January rise	748	1,191	..
February ..	3,130	3,277 from 5th February rise	3,313* from 8th February rise	..
March ..	2,130	4,251	3,714	..
April ..	2,229	2,028	4,235	3,020
May.. ..	2,164	3,297	9,469	8,970
June.. ..	5,347	3,208	5,989	9,496
July ..	4,923	2,739	2,555	5,569
August ..	3,988	2,710	3,111	2,915
September ..	3,255	2,928	4,015	2,957
October ..	1,530 from 9th October fall	2,934 from 15th October fall	3,255 from 13th October fall	1,704†
November ..	1,859	2,250	1,683	..
December ..	1,879	1,852	4,014	..

* = Rise about 100 bundles of ice.

† = After 10th fall below 100 bundles of ice.

* The italics are of Nayudu.

† *Vide* Nayudu, 1939. The above figures are in bundles of ice, each containing 1½ maunds approximately. One maund = 82·28 lb.

The quantity of ice required to pack a unit weight of fish varies from season to season. In summer more of ice is used than in winter. On an average it is said that a bundle of 1·5 maunds of ice is used to pack about 2·5 maunds of fish. Even without converting the output of ice into terms of fish weight, the figures should give a fairly correct index of the trend in the *Hilsa* fishery in the Goalundo area of the Ganges, as according to him, the marked fall or rise is based on the *Hilsa* catches.

TABLE II*

Monthly supply of fish in Maunds † to Calcutta from Goalundo and Lalgolaghat during the year 1954

Month	*Goalundo*		*Lalgolaghat*	
	All varieties of fish	*Hilsa* only	All varieties of fish	*Hilsa* only
January ..	25,916	..	112	29
February ..	24,810	1,235	804	201
March ..	17,593	934	752	188
April ..	5,097	614	1,274	344
May.. ..	2,560	2,121	899	274
June.. ..	25,864	25,864	1,653	1,613
July ..	26,989	26,898	4,765	4,765
August ..	15,653	15,524	7,140	7,140
September ..	37,364	37,281	12,179	12,179
October ..	21,082	20,299	1,572	1,566
November ..	35,584	821	14	..
December ..	44,449	4	69	9
Total ..	2,82,961	1,31,595	31,233	28,308

* These figures are kindly furnished by Mr. Ajit Das Gupta, Marketing Officer, Bengal Fisheries Department, to whom my thanks are due.

† One maund = 82·28 lb.

During the three years for which complete figures are available, it is interesting to note that the rise and fall in the output of ice in Goalundo

coincides with the beginning and the end of the *Hilsa* fishing season in the rivers. In the absence of information on the fish supplies on a varietal basis, it is difficult to say exactly how much of the ice consumed was used for packing

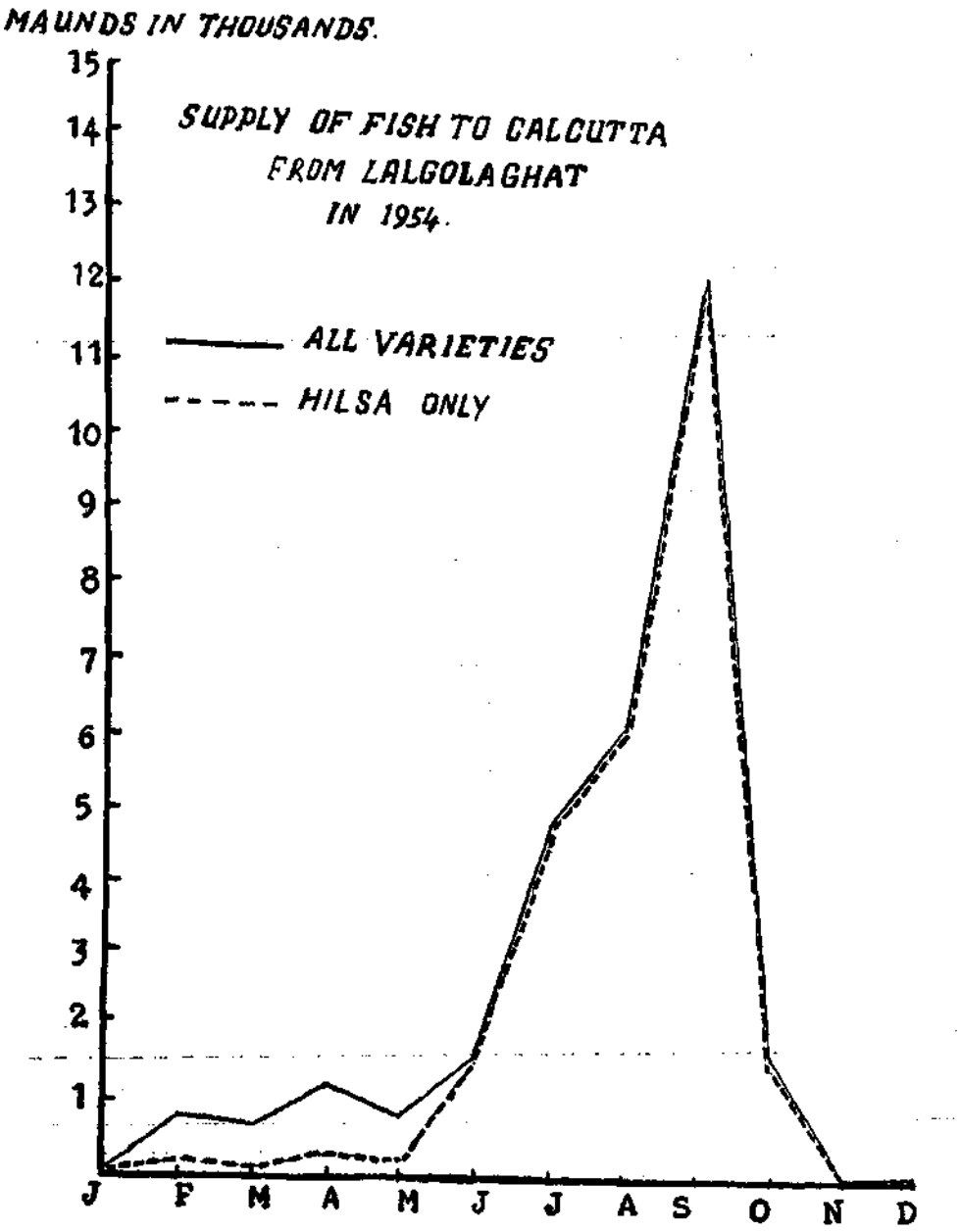

FIG. 3. Graph showing the supply of fish from Lalgolaghat to the Calcutta Markets in 1954.

Hilsa. In Table II, the total quantities of fish received in 1954 from Goalundo and Lalgolaghat by the Calcutta markets, with the proportion of *Hilsa* in them, are given for comparison.

If we are to presume that the general trend in the *Hilsa* fishery has been the same in the previous years also, it is obvious that the inference drawn by Nayudu (*op. cit.*) is more or less correct. The 1954 figures for *Hilsa* both in Goalundo and Lalgolaghat show practically the same pattern of increase and decrease. The first wave of migration, after the peak of winter, is indicated by the availability of the fish in Goalundo in February followed by a slight decline in March and April (Fig. 2). An appreciable increase is seen in May, and from June-October the peak supply is registered with a sharp decline from November-January. The same trend is reflected in Lalgolaghat (Fig. 3) which is situated over 100 miles above Goalundo.

It is evident that the monsoon rains and the resultant floods that occur at a time when temperature reaches the maximum range, are responsible for the major run from May-June to October. With the subsidence of floods and the general lowering of temperature by the latter half of October, the reduction in the migratory activity is reflected in the lower supplies. As regards the late winter run that commences by about February, it has been regularly observed in the Hooghly that the rains as a contributory factor do not come into the picture, as the ascent of the fish takes place in the absence of any rains. Floods are out of the question at this time, since the upper stretch of the river (Bhagirathi) is cut off from the main Ganges, due to heavy silting by about December every year and there is no chance of it receiving any flood waters till about June.

TABLE III

*Average monthly rainfall in inches in the Drainage area of the Ganga System**

Zones	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Assam ..	0·67	1·53	4·00	9·00	12·08	18·23	18·74	16·83	12·50	5·66	0·90	0·34
Bengal ..	0·34	0·95	1·67	3·25	7·64	14·62	15·14	14·28	10·89	5·08	0·79	0·16
Chotanagpur	0·77	1·15	0·93	0·70	2·13	8·97	12·91	13·77	8·10	2·92	0·39	0·14
Bihar ..	0·42	0·62	0·47	0·64	2·27	7·78	12·36	12·51	8·80	2·32	0·29	0·09
U.P. East ..	0·63	0·55	0·32	0·19	0·67	4·78	11·55	11·33	6·87	1·87	0·19	0·22
U.P. West ..	0·96	0·89	0·61	0·30	0·68	4·06	11·47	11·14	5·96	0·88	0·15	0·36
C.I. East ..	0·56	0·63	0·33	0·22	0·43	4·50	12·04	12·49	6·36	1·17	0·35	0·21

* From records up to 1920 (*vide* Hora and Nair, 1940).

Table III gives the average monthly rainfall in the area drained by the Gangetic system of rivers. Except in the Assam sector which is drained by the Brahmaputra, in other areas the average rainfall is comparatively low from November-March, and as explained already, it is quite inadequate to create floods in the Hooghly. We are, therefore, left to consider, as suggested previously, the rise in temperature as the probable factor for this late winter and early spring migration of the fish. The monthly variations in temperature in three centres in the Hooghly, *viz.*, Barrackpore, Calcutta and Diamond Harbour for one year (1952-53) are shown graphically in Fig. 4.* Diamond Harbour is about 36 miles south of Calcutta and Barrackpore

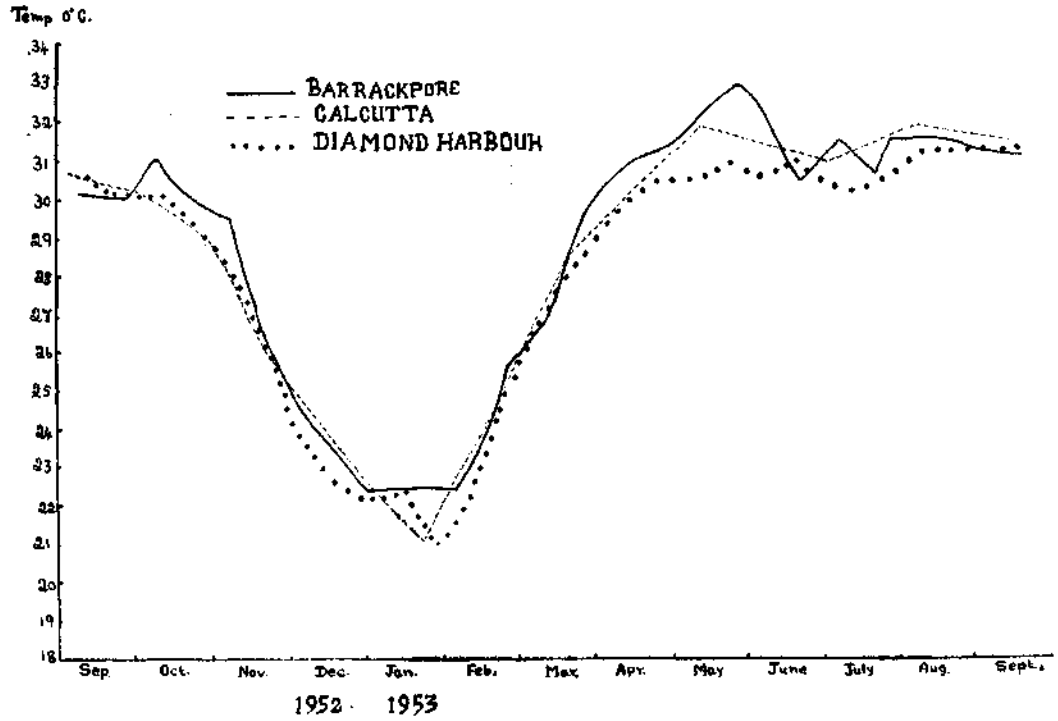

FIG. 4. Graph showing the water temperature of the Hooghly in 1952-53 at Barrackpore, Calcutta and Diamond Harbour.

about 18 miles north (Fig. 1). The difference in temperature of the water is very negligible and a uniform trend is seen in all the places. The lowest temperature is recorded in January and the general rise commencing by February is maintained uninterruptedly till the advent of the monsoon rains in May-June. As this seasonal fluctuation is a regular annual cyclic feature,

* The above graph has been kindly prepared and furnished by Shri B. Bose of the Central Inland Fisheries Research Station, Calcutta.

it could safely be presumed that the general trend in temperature variation should be more or less similar in all the rivers of the Gangetic Delta.

From November-January-February *Hilsa* moves about in large shoals in the mouths of estuaries and along the foreshore areas of the Bengal-Orissa Coast and even as far south as the Mergui Archipelago on the Burma Coast (Kyaw, 1953). The fact that, with the general rise in temperature in the rivers during the latter part of winter the migration also takes place is an argument in favour of the view that temperature is the main contributory factor for this run. Further, the above conclusion gets support in the findings of Talbot (*op. cit.*) regarding the environmental factors inducing the American shad, *Alosa sapidissima*, to move up stream.

There is considerable scope for further work on this interesting problem of *Hilsa* migration. It is hoped that the work done hitherto will serve usefully for planning and conducting further investigations. Whether the fish in the first run of the early part of the year and those of the major run during the monsoon months, form a single stock or are of different stocks, though morphologically they appear similar, and how many times and at what intervals the same fish could breed are interesting subjects for study.

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